CLAIMS

What is claimed is:

1. A system having a solid-state gyro with a single sheet of piezoelectric material forming a plurality of piezoelectric elements, capable of displaying gyroscopic navigational attitude information, direction information, and turn coordinate information simultaneously on a display.

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2. A gyroscopic navigation system, comprising:

a first sensor module, having a plurality of electrical rotational rate sensors, for providing a plurality of rotational rate signals;

a second sensor module, having a plurality of electrical compensation sensors, for providing a plurality of compensation signals;

a microcontroller module, coupled to the first and second sensor modules, for processing the rotational rate signals and the compensation signals; and

a display, coupled to the microcontroller module, for displaying attitude information, directional information, and turn coordinate information simultaneously.

3. The system of claim 2, wherein the rotational rate sensors are made of piezoelectric elements, the piezoelectric elements are made from a single sheet of piezoelectric material.

4. The system of claim 3, wherein one of the rotational sensors is a directional gyro, and another rotational sensor is an attitude gyro.

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5. The system of claim 4, wherein each of the directional and the attitude gyros is a three-dimensional solid-state gyro which comprises:

a substrate having a proof-mass;

a membrane, the proof-mass being suspended on the membrane;

a single common electrode layer being disposed on the membrane;

the single sheet of piezoelectric material being disposed on the single common electrode layer; and

a plurality of electrodes being disposed on the single sheet of piezoelectric material, the rotational rate signals being outputted through the electrodes, wherein each of the electrodes, the piezoelectric material, and the single common electrode layer form a plurality of piezoelectric elements.

6. The system of claim 5, wherein the piezoelectric elements are arranged and configured in a circular shape with a plurality of pairs of piezoelectric elements, one element in a pair is disposed on an inner ring of the circular shape, and the other element in the pair is disposed on an outer ring of the circular shape.

7. The system of claim 6, wherein the two elements of the pair have equal area.

8. The system of claim 7, wherein each pair of piezoelectric elements has a mirror image pair of piezoelectric elements disposed on opposite side of an axis passing through a center of the proof-mass.

9. The system of claim 5, wherein the piezoelectric elements are arranged and configured in an oval shape with a plurality of pairs of piezoelectric elements, one

element in a pair is disposed on an inner ring of the oval shape, and the other element in the pair is disposed on an outer ring of the oval shape.

10. The system of claim 9, wherein the two elements of the pair have equal area.

11. The system of claim 10, wherein each pair of piezoelectric elements has a mirror image pair of piezoelectric elements disposed on opposite side of an axis passing through a center of the proof-mass.

12. The system of claim 2, wherein the compensation sensors provide acceleration, magnetic field, and temperature compensation signals to reduce correlated noise caused by acceleration, magnetic field, and temperature.

13. The system of claim 2, further comprising a power management module, the power management module being coupled to and supplying power to the first sensor module, the second sensor module, the microcontroller module, and the display, wherein the power management module includes a switch capable of switching between a primary power source and a battery power source, wherein under a normal condition, the switch is switched to connect to the primary power source, and in the event that the primary power source fails, the switch is switched to connect to the battery power source, the battery power source then supplies power to the first and second sensor modules, the microcontroller module, and the LCD display, etc.

14. The system of claim 13, wherein under the normal condition, the primary power source charges battery of the battery power source.

15. The system of claim 2, further comprising a converter for automatically converting the rotational rate signals and the compensation signals before sending the rotational rate signals and the compensation signals to the microcontroller.

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~~16.~~ A solid-state gyro, comprising:

a substrate having a proof-mass;

a membrane, the proof-mass being suspended on the membrane;

a single common electrode layer being disposed on the membrane;

the single sheet of piezoelectric material being disposed on the single common electrode layer; and

a plurality of electrodes being disposed on the single sheet of piezoelectric material, the rotational rate signals being outputted through the electrodes, wherein each of the electrodes, the piezoelectric material, and the single common electrode layer form a plurality of piezoelectric elements.

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~~17.~~ The gyro of claim 16, wherein the piezoelectric elements are arranged and configured in a circular shape with a plurality of pairs of piezoelectric elements, one element in a pair is disposed on an inner ring of the circular shape, and the other element in the pair is disposed on an outer ring of the circular shape.

18. The gyro of claim 17, wherein the two elements of the pair have equal area.

19. The gyro of claim 18, wherein each pair of piezoelectric elements has a mirror image pair of piezoelectric elements disposed on opposite side of an axis passing through a center of the proof-mass.

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20. The system of claim 16, wherein the piezoelectric elements are arranged and configured in an oval shape with a plurality of pairs of piezoelectric elements, one element in a pair is disposed on an inner ring of the oval shape, and the other element in the pair is disposed on an outer ring of the oval shape.

21. The system of claim 20, wherein the two elements of the pair have equal area.

22. The system of claim 20, wherein each pair of piezoelectric elements has a mirror image pair of piezoelectric elements disposed on opposite side of an axis passing through a center of the proof-mass.

23. An aircraft instrument system, comprising:

a plurality of aircraft primary instruments including a mechanical attitude gyro, a mechanical directional gyro, a mechanical-electrical turn coordinator/slip-skid indicator;

a standby gyroscopic navigation system connected independently of the primary instruments;

electrical power having a primary power source and a battery power source, the primary power source supplying power to the primary instruments and the standby gyroscopic navigation system, the standby battery power source supplying power to the standby gyroscopic navigation system to provide attitude information, directional information, and turn coordination information when the primary power source fails.

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24. The system of claim 23, wherein standby gyroscopic navigation system includes:

a first sensor module, having a plurality of electrical rotational rate sensors, for providing a plurality of rotational rate signals;

a second sensor module, having a plurality of electrical compensation sensors, for providing a plurality of compensation signals;

a microcontroller module, coupled to the first and second sensor modules, for processing the rotational rate signals and the compensation signals; and

a display, coupled to the microcontroller module, for displaying attitude information, directional information, and turn coordinate information simultaneously.

25. The system of claim 24, wherein the rotational rate sensors are made of piezoelectric elements, the piezoelectric elements are made from a single sheet of piezoelectric material.

26. The system of claim 25, wherein one of the rotational sensors is a directional gyro, and another rotational sensor is an attitude gyro.

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27. The system of claim 26, wherein each of the directional and the attitude gyros is a three-dimensional solid-state gyro which comprises:

a substrate having a proof-mass;

a membrane, the proof-mass being suspended on the membrane;

a single common electrode layer being disposed on the membrane;

the single sheet of piezoelectric material being disposed on the single common electrode layer; and

a plurality of electrodes being disposed on the single sheet of piezoelectric material, the rotational rate signals being outputted through the electrodes, wherein each of the electrodes, the piezoelectric material, and the single common electrode layer form a plurality of piezoelectric elements.

28. The system of claim 27, wherein the piezoelectric elements are arranged and configured in a circular shape with a plurality of pairs of piezoelectric elements, one element in a pair is disposed on an inner ring of the circular shape, and the other element in the pair is disposed on an outer ring of the circular shape.

29. The system of claim 27, wherein the two elements of the pair have equal area.

30. The system of claim 29, wherein each pair of piezoelectric elements has a mirror image pair of piezoelectric elements disposed on opposite side of an axis passing through a center of the proof-mass.

31. The system of claim 27, wherein the piezoelectric elements are arranged and configured in an oval shape with a plurality of pairs of piezoelectric elements, one element in a pair is disposed on an inner ring of the oval shape, and the other element in the pair is disposed on an outer ring of the oval shape.

32. The system of claim 31, wherein the two elements of the pair have equal area.

33. The system of claim 32, wherein each pair of piezoelectric elements has a mirror image pair of piezoelectric elements disposed on opposite side of an axis passing through a center of the proof-mass.

34. The system of claim 24, wherein the compensation sensors provide acceleration, magnetic field, and temperature compensation signals to reduce correlated noise caused by acceleration, magnetic field, and temperature.

35. The system of claim 24, further comprising a converter for converting the rotational rate signals and the compensation signals before sending the rotational rate signals and the compensation signals to the microcontroller.

36. A system having a solid-state gyro with a single sheet of piezoelectric material forming a plurality of piezoelectric elements in an oval shape, capable of displaying gyroscopic navigational information on a display.

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37. A gyroscopic navigation system configuring a plurality of sensors on a single multi-sensor chip, capable of displaying gyroscopic navigational information on a display.

38. The system of claim 37, wherein the sensors include a solid-state gyro and a compensation sensor with shared lower electrode layer and shared piezoelectric layer.

39. The system of claim 37, wherein the sensors include a solid-state gyro and a compensation sensor with separate lower electrode layer and separate piezoelectric layer.

40. The system of claim 37, wherein the system displays the gyroscopic navigational information, including attitude information, direction information, and turn coordinate information, simultaneously on the display.

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